
SOUTH FLORIDA WATER MANAGEMENT DISTRICT



IMPROVEMENTS NEEDED IN CAPITAL MAINTENANCE PROTOCOL FOR THE CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL SYSTEM

Audit #01- 18

**Prepared By
Office of Inspector General**

**Allen Vann, Inspector General
Christian Flierl, Lead Consulting Auditor**



SOUTH FLORIDA WATER MANAGEMENT DISTRICT

3301 Gun Club Road, West Palm Beach, Florida 33406 • (561) 686-8800 • FL WATS 1-800-432-2045 • TDD (561) 697-2574
Mailing Address: P.O. Box 24680, West Palm Beach, FL 33416-4680 • www.sfwmd.gov

MGT 08-06F

August 13, 2001

Audit Committee Members:

Mr. Gerardo B. Fernandez, Chairman
Mr. Lennart E. Lindahl, Vice-Chair
Ms. Pamela D. Brooks-Thomas, Member
Mr. Michael Collins, Member
Mr. Patrick J. Gleason, Member

RE: Final Report –
Improvements Needed
in Capital Maintenance
Protocol for the Central
and Southern Florida
Flood Control System
Audit # 01-18

This audit was performed pursuant to the Inspector General's authority set forth in Chapter 20.055, F.S. The audit focused on the process that is in place to ensure that the regional flood control system infrastructure is adequately maintained. Our audit analyzed the District's Five-Year Capital Improvements Plan for fiscal years FY99, FY00 and FY01. In addition, we reviewed the FY02 regional flood control system capital improvement budget submission and the process used to prepare it. Fieldwork was conducted during June 2001. This report was prepared by Chris Flierl.

Sincerely,

Allen Vann
Inspector General

AV/cf
Enclosure

c: Henry Dean
George Horne

GOVERNING BOARD

Trudi K. Williams, *Chair*
Lennart E. Lindahl, *Vice Chairman*
Pamela Brooks-Thomas

Michael Collins
Hugh M. English
Gerardo B. Fernandez

Patrick J. Gleason, Ph.D., P.G.
Nicolas J. Gutierrez, Jr., Esq.
Harkley R. Thornton

EXECUTIVE OFFICE

Henry Dean, *Executive Director*

TABLE OF CONTENTS

BACKGROUND	1
OBJECTIVES, SCOPE, AND METHODOLOGY	2
FINDINGS AND RECOMMENDATIONS	
SUMMARY	3
A Complete Life-Cycle Based Inventory Of The C&SF Is Needed	4
Engineering-Based Inspections Should Be Routinely Performed	7
5-Year Capital Maintenance Plan Lacks Predictive Value	11
Capital Maintenance Program Requires Consistent Annual Funding Commitments.....	13

Background

The Central and Southern Florida Flood Control Project (C&SF) was created by an act of the US Congress in 1948. In 1949, the Florida Legislature created the Central and Southern Florida Flood Control District, the predecessor to the South Florida Water Management District. Currently, this system encompasses 1,800 miles of canals and levees, 25 major pumping stations and 200 large and 2,000 small water control structures. This system has an estimated replacement value of approximately \$4 billion.

As local sponsor, the District is required to maintain the conveyance capacity of the system and to implement incremental maintenance efforts to ensure that the flood protection and water supply capabilities of the system are maintained for future generations. Various system components are reaching the end of their productive life. As such, it is important to assess the



Figure 1 - S65E

condition of infrastructure and plan for the necessary capital repairs or replacements so as to maintain the productive capacity of the system and prevent failure.

The Water Resources Operations Business Group (WRO) is the operating unit that is responsible for budgeting for and maintaining the regional flood control system. The Engineering & Project Management Department of Water Resources Management Business Group (WRM) provides engineering and project management support for regional flood control system capital projects.

Objectives, Scope, and Methodology

The objective of this audit was to determine if the District has an effective process in place for maintaining the Central and Southern Florida Flood Control Project (C&SF) to design capacity.

The scope was limited to the original C&SF system including water control structures, pump stations, canals, project culverts, navigational locks and any other C&SF infrastructure that was turned over to the District by the US Army Corp of Engineers (Corp). However, the recommendations apply universally to all District capital assets.

We gained a thorough understanding of the process that the District currently uses to maintain the C&SF system and compared and contrasted them with practices recommended by the United States General Accounting Office in their audit of the Defense Department's capital program.

Our audit was conducted in accordance with generally accepted government auditing standards.

FINDINGS AND RECOMMENDATIONS

SUMMARY

The District does not have a comprehensive strategy in place for ensuring that the regional flood control system is maintained to design capacity. Instead, initiatives to assess and fund the system have been sporadic. While the District prepares a 5-year Capital Improvement Plan and performs facilities inspections, these activities do not necessarily result in an effective long-term, strategic maintenance plan. Then again, during the FY02 budget cycle, Water Resources Operations (WRO) has taken the following steps towards implementing a more comprehensive strategy:

- Compiling a complete inventory of regional flood control system infrastructure,
- Establishing an engineering-based system for assessing facility conditions, using trained personnel and multiple levels of review, and
- Identifying, creating, and prioritizing a backlog of capital maintenance projects.

A promising practice used elsewhere is life-cycle planning. Capital assets are classified by their various major components, for which the useful life of each is determined. Knowing when facility components will require replacement would help the District to project peaks and valleys of future maintenance requirements. We recommend that the District move towards life-cycle planning for capital assets.

Apart from the challenges of developing an accurate and supportable capital plan, a commitment to long term funding is needed to ensure its viability. A consistent commitment of funds will be required to reduce the current maintenance backlog and to perform preventative maintenance and repair activities. The District's past (annual) budget cycle has sustained only the most immediate capital maintenance needs. For example, of the \$31.6 million of "critical" and high priority regional flood control system capital maintenance needs identified by WRO for FY02 funding, only \$7 million in projects will likely be funded. According to WRO estimates, at this level of funding in 20 years, adjusted for inflation, the District's capital maintenance backlog will almost triple to an amount approaching three-quarters of a billion dollars.

A Complete Life-Cycle Based Inventory Of The C&SF Is Needed

We learned from WRO management that an inventory of the regional flood control system assets does not currently exist in a form that is complete and detailed enough for capital maintenance planning. The identification of system infrastructure is a vital first step in formulating a comprehensive capital maintenance program. The asset inventories in the financial system and the maintenance management system are either incomplete or lack sufficient detail to be useful for capital maintenance planning purposes. This could result in a system component being overlooked and possible failure of that component. WRO is currently in the process of compiling this data.

In order for WRO to effectively manage their capital maintenance program, a database of every regional flood control system asset should be created that details each structure by major component. For example, a pump station is comprised of the following individual components:

- Motors – can be either electric or diesel
- Gears – reduction gear used to slow the rpm's off the motor to the pump
- Housing – the metal structure that houses the pump components
- Pump – the gears, impeller and shaft inside the housing
- Structural – the building that houses the pump station
- Backflow gates
- Fuel Storage Tanks (if diesel powered)
- Trash rake
- Generators

Each of these components has different maintenance requirements and different useful lives. As such, having information about each component of the structure (date placed in service, useful life, current assessment of the component, etc.) is critical to designing an effective capital maintenance program. Our audit revealed that neither the financial accounting system nor the Computerized Maintenance Management System¹ provides a complete facility inventory in the required level of detail. WRO is currently working on compiling a database that will include all C&SF infrastructure assets (except canals and levees) to facilitate capital maintenance.

¹ See Audit Report 01-10 Post Implementation Status of the District's Computerized Maintenance Management System issued May 10, 2001.

Not until all of the C&SF infrastructure assets are adequately inventoried can there be any assurance that the needs and risks associated with maintaining the system are accurately reflected in the capital plan. To this end, life-cycle planning would be useful. Life-cycle planning is a means of managing capital assets that entails estimating the useful lives of the various components in a facility and preparing a plan to replace those components when necessary. With life-cycle planning, an organization can project peaks and valleys of future maintenance spending and estimate the funding level required to sustain a facility through its life cycle. Large capital expenditures can be anticipated more predictably. The District currently doesn't use life-cycle planning. While the District uses the CMMS system to plan routine maintenance, it is not used to plan component replacement. Life-cycle planning, if properly used, can reduce major repair costs.

The U.S. General Accounting Office has found one Defense Department entity, the Army's Health Facility Planning Agency (HFPA), using life-cycle principles for facility management to manage over 1,600 hospitals, clinics, and other health-related facilities. HFPA prioritizes capital maintenance spending based on a combined assessment of predicted need over a life-cycle, known physical deficiencies, and mission impact, and targets funds for those facilities that serve the largest number of people. It assumes a 50-year facility replacement cycle and uses life-cycle estimates to optimize investments in operations, maintenance, repairs, and minor construction. HFPA reports that in the 5 years that it has used life-cycle costing and budgeting, it has reduced its anticipated major repair costs by 50 percent.

The development of a database of all facility components is a first step in moving towards life-cycle planning. Given the funding issues that need to be resolved just to start reducing the current capital project backlog, it may be premature to recommend that life-cycle planning for capital assets be implemented at this time. However, while WRO is in the process of creating their database, consideration should be given towards including data about the useful life of each component, the remaining life and the cost to replace each component. This information will make future budget requests more reliable.

Recommendations:

- 1. WRO should be provided with the resources needed to complete their database of C&SF infrastructure assets.**

Management Response: WRO agrees that the identification of system infrastructure is a vital first step in formulating a comprehensive capital maintenance program. A database of every regional flood control system assets was compiled and field validated. The electronic support for the database was not included in the FY02 requests due to limited resources. This development of this database is a first step in lifecycle costing and budgeting. WRO is committed to complete the detailed electronic format; however, to fully implement a capital assets database for lifecycle planning will require additional resources and funding not currently allocated to WRO.

Responsible Department: WRO.

Estimated Completion Date: If resources are allocated to WRO, the database can be completed in approximately one year.

- 2. The District should begin to incorporate the principles of life-cycle planning for capital assets by putting life-cycle information into their structure database.**

Management Response: Lifecycle information will be implemented into a database in a phased manner. Total data input may take up to three years to complete and validate because of the large number of capital assets in the C&SF system. Each asset has a large number of components, compounding the database structure. The WRO capital improvements will be addressed in a District wide approach to optimize the use of resources. Furthermore, additional consideration is given to the possible replacement of outmoded equipment, especially when it is cost effective to do so instead of continually spending funds and resources to operate and maintain the outmoded equipment.

Responsible Department: WRO

Estimated Completion Date: If resources are allocated to WRO, the life cycle information can be completed in approximately two years.

Engineering-Based Inspections Should Be Routinely Performed

Engineering-based inspections of C&SF assets have not been routinely performed. Inspecting and assessing the various components of the regional flood control system is essential to maintain the system to design capacity, as required. One of the promising practices in property management reported by the General Accounting Office² is to have a single, valid engineering-based system for assessing facility conditions using adequately trained personnel at multiple levels of review.

Up until recently, the only inspections of the C&SF system performed were semi-annual inspections required by the U.S. Army Corp Of Engineers. District Field Station personnel perform these inspections within their service area. Discussions with WRO staff revealed that standard criteria and procedures are not used and the inspections are not engineering-based. Realizing the limited value of these semi-annual inspections, WRO is currently in the process of implementing a new initiative, the *Field Operations Readiness and Standardization Program* that includes engineering-based structure inspections using consistent criteria District-wide.

As local sponsor for the C&SF, the District is required to ensure that the flood protection and water supply capabilities of the original C&SF design are maintained. Knowing the status of system components is essential to determining whether the system is operating at design capacity.

One of the consequences of not performing routine engineering-based inspections is that capital maintenance projects may not be identified in a timely manner. For example, recently pump station S-7 was completely dewatered so that it could be inspected. The structure is going to serve as an out-flow point for STA 3-4. The inspection revealed that the underlying concrete slab had sustained serious structural damage under the intake side of the pump and damage to the structure supporting the pumps.³ If not for the fact that this structure was going to be a part of STA 3-4, the detailed inspection would not have taken place and failure might have occurred.

² Report #GAO/NSIAD-99-100, MILITARY INFRASTRUCTURE, *Real Property Management Needs Improvement*.

³ It is not yet known what the cost will be to repair the structure. An engineering firm has been hired to identify options.

While engineering-based inspections aren't routinely performed, two significant one-time initiatives were undertaken by the District to determine the status of the C&SF infrastructure, the Canal Conveyance Capacity and the Structure Inspection programs. These were both necessary, albeit costly, one-time initiatives conducted in order to assess the status of the regional flood control system.



Figure 2 – S-7 scour hole.

The Canal Conveyance Capacity Program began in 1990 when the Operation & Maintenance Department (the predecessor of WRO) initiated a District-wide cursory study of 113 canals in the C&SF. This study cost the District approximately \$500,000 in consulting fees and concluded that 25 canals had lost conveyance capacity or had developed shoaling.⁴ Of the 25, the field stations had performed isolated dredging efforts on 11 and cooperated with the Corps to dredge five others. Further, three of the identified canals were to be dredged as a part of the Kissimmee River Restoration Project. For the remaining six canals, the District retained the services of engineering consulting firms to further evaluate their conveyance capacity.

The District adopted a 12 year plan to restore these canals to design capacity. It was estimated that this would cost approximately \$44.7 million through FY10. Also, on a go-forward basis, OMD committed to performing incremental canal profile evaluation using GIS/GPS equipment to identify areas where shoaling has occurred. The goal being to remove smaller shoals, while eliminating the backlog of shoal removal identified.

Our analysis of the District's 5 Year Capital Program reveals that little has been done to remove shoals in canals other than those identified under the Canal Conveyance Capacity Program. Further, if the Program stays on schedule, it will have taken 20 years since the program began to complete those projects, which represents only a relatively small fraction of the total length of the C&SF System.

⁴ Shoaling is an accumulation of material in a canal that impedes the flow of water.

Another one-time initiative undertaken by the District was the Structure Inspection Program. Between 1993 and 1996, the District hired consultants to inspect the water control structures while District personnel inspected the project culverts and bridges. The cost of outside consultants alone for this program approached \$600,000. These engineering studies are still used as benchmarks when performing structure inspections.

Finally, according to WRO Project Management and Engineering staff, the District is required by the Corps to perform semi-annual inspection of the regional flood control system. These inspections are of little value for capital maintenance planning because they are cursory in nature and are not performed by adequately trained personnel applying standardized criteria. The lack of uniform criteria means that structures in a similar condition could receive different ratings. The lack of training could mean that engineering problems aren't identified.

WRO has recognized the need for thorough, standardized, engineering-based inspections and has responded by recently initiating a new program called the *Field Operations Readiness and Standardization Program*. This program is designed to:

- emphasize readiness and standardization as a daily process with management to be continually aware of factors that limit the ability of District facilities to safely operate as design limits,
- improve safety and proficiency by standardizing procedures,
- ensure that District facilities and real property are maintained under their prescribed preventative maintenance systems,
- ensure that District facilities and real property are supported and maintained in accordance with configuration management requirements, and
- provide a uniform method of measuring readiness and compliance with program standards.

This program will ensure that the appropriate individuals using standardized criteria, will annually inspect District structures. It should be noted that it may subsequently be determined that annual inspections might be impractical or too frequent for certain classes of infrastructure assets or for assets that have

only recently been placed into service. WRO management should decide the optimum inspection interval for each asset.

Recommendation:

- 3. WRO should determine, and adhere to, an inspection schedule for each class of infrastructure asset, and to the extent possible implement its proposed new *Field Operations Readiness and Standardization Program*.**

Management Response: We concur with the recommendation. The Field Operations Readiness and Standardization Program will be implemented on an accelerated schedule.

Responsible Department: WRO

Estimated Completion Date: July 2002

5-Year Capital Maintenance Plan Lacks Predictive Value

The District is required to develop a 5-Year Capital Maintenance Plan. Section 373.079 (4)(b)3, of the Florida Statutes states that:

Within 45 days of the adoption of the final budget, the governing board shall submit a 5-year capital improvement plan and fiscal report for the district to the Governor, the President of the Senate, the Speaker of the House of Representatives, and the Secretary of Environmental Protection. The capital improvement plan must include expected sources of revenue for planned improvements and shall be prepared in a manner comparable to the fixed capital outlay format set forth in s. 216.043. The fiscal report shall cover the preceding fiscal year and shall include a summary statement of the financial operations of the district.

As a tool for long-range capital maintenance planning, the 5-Year Capital Maintenance Plan (the "Plan") is of questionable value. The estimates of future year capital expenditures bear little or no relationship to actual budgeted expenditures. Further, projects appear with no prior indication and projects drop off.

Estimates contained in the Plan of expenditures in the out years bear little similarity to amounts actually budgeted. For the most part, new projects were identified that resulted in a higher level of expenditures than anticipated. For example, the FY99 Plan estimates that in FY00, \$9 million will be spent on regional flood control system capital projects. However, the amount actually approved for these projects in the FY00 budget totaled \$12.6 million. Similarly, the FY00 Plan estimates FY01 capital projects relating to the regional flood control system to be \$13.3 million, when in fact, the approved capital budget was \$21.3 million.

We also noted an instance where a needed project dropped off the Capital Plan then reappeared. The FY99 Capital Plan indicated that the Corkscrew Canal Improvement Project for \$1 million would begin in FY02. The FY00 capital plan makes no mention of the Corkscrew Canal Improvement Project. However, it shows up again on the FY01 capital plan as a FY04 expenditure of \$1.5 million.

As can be seen, the 5-year Capital Maintenance Plan, overall, tends to understate future capital expenditures, although identified projects can also drop off the plan.

Recommendation:

- 4. The 5-Year Capital Maintenance Plan should be viewed as a tool for capital maintenance planning, not just as a statutory reporting requirement.**

Management Response: The capital maintenance plan will be implemented as a management tool for capital maintenance planning and will be used as a basis for resource management and project planning including budget development and contract administration. For FY02, we are currently using the plan to better manage our capital assets. Additional resources and funding for meeting this recommendation would be useful in implementing an assertive capital maintenance program.

Responsible Department: WRO

Estimated Completion Date: July 2002

**Capital Maintenance Program
Requires Consistent Annual
Funding Commitments**

The annual amount budgeted for capital improvements have not been adequate to support a comprehensive long-range capital maintenance strategy. In order for a long-range strategic capital maintenance plan to be successful, a consistent funding approach will be required to reduce the maintenance backlog and to perform necessary preventative maintenance and repair activities.

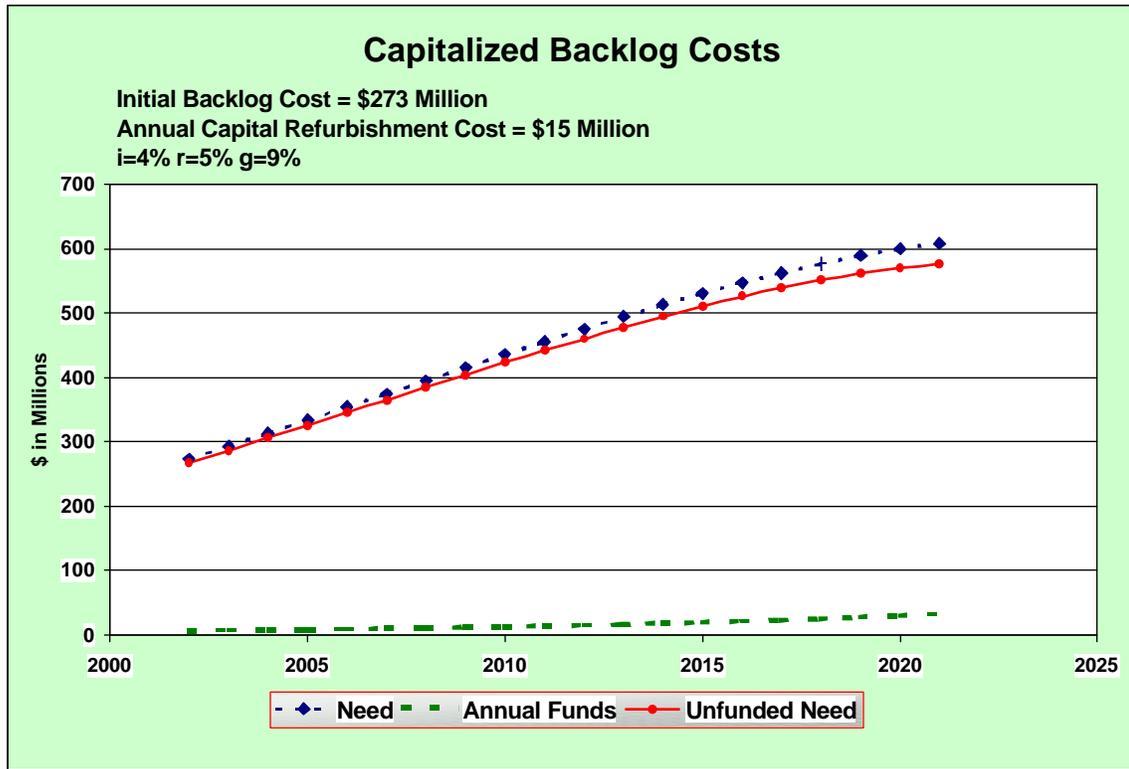
In the past, it could not be determined in any budget year what impact current year funding had on the total backlog of capital programs because the backlog was unknown. This results in capital maintenance budgets that bear no relationship to actual needs. WRO currently estimates that a capital maintenance backlog for regional flood control system projects approximate \$273 million. Capital maintenance budget requests totaling over \$31 million were submitted by WRO for inclusion in the FY02 budget.

Regional Flood Control System Projects Submitted for FY02 Funding	Number of Projects	Value of Projects	Amount Funded
“Critical”	24	\$19,241,000	\$6,318,000
High Priority	<u>20</u>	<u>12,315,000</u>	<u>800,000</u>
Totals	44	\$31,556,000	\$7,118,000

Of the \$31.6 million in “critical” and high priority projects, we noted that only \$7.1 million was included in the proposed FY02 budget. The largest cuts made were to two “critical” regional flood control system projects the C-16 and C-23 dredging projects. WRO requested a total of approximately \$8.3 million for these two projects but received only \$650,000 for the C-23 project alone. Both of these projects were identified in the Canal Conveyance Capacity Program as canals that had lost conveyance capacity and were scheduled to be dredged. Some dredging of C-23 was funded during FY00 and FY01. Conversely, the C-16 project wasn’t scheduled to commence significant activity until FY09. Notably, both of these projects were mentioned in the *Hurricane Irene After-Action Assessment*⁵ as factors contributing to the flooding, however, neither received significant FY02 funding.

⁵ The *Hurricane Irene After-Action Assessment*, dated December 9, 1999, in part, assessed the performance of the District’s infrastructure during Hurricane Irene.

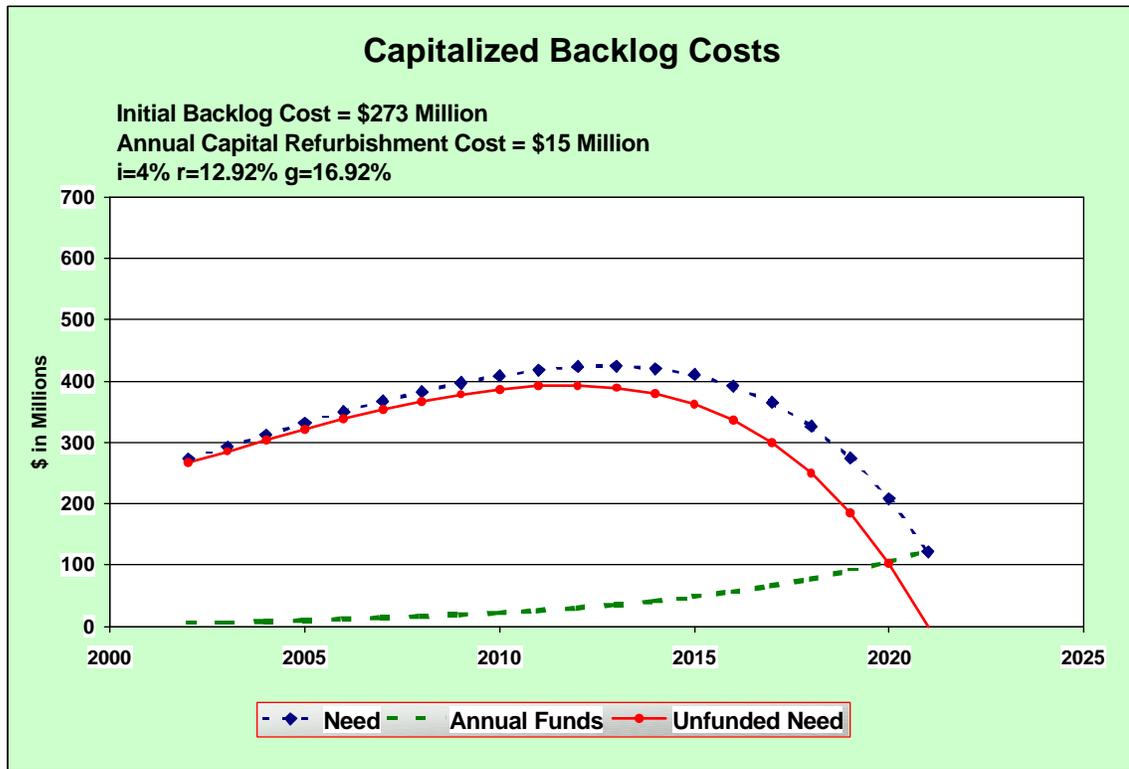
WRO estimates that if the funding rate for capital maintenance remains unchanged, the backlog in 20 years, after adjusting for inflation, could approach \$741 million; three times what it is currently estimated to be. The graph below illustrates what the backlog would be assuming a 5% real growth rate in capital maintenance funding.



Source: Unaudited WRO furnished graph.

This graph assumes a 9% growth rate in capital project funding requirements consisting of 4% inflation plus real growth of 5%. It also assumes capital maintenance needs of \$15 million annually. Under this scenario a \$576 million capital maintenance backlog will still exist after 20 years. WRO staff believes that their estimate of the backlog is a conservative one given that not all identified projects have been validated and not all structures have been thoroughly inspected. They also represented to us that the \$15 million is a conservative estimate and does not include any new (ECP and CERP) or unforeseen projects, other than those they have already identified.

WRO estimates that a 17% growth rate (real growth of 13%) in capital maintenance spending will be required to eliminate the backlog log in 20 years as depicted in this next graph.



Source: Unaudited WRO furnished graph.

Now that WRO has taken preliminary steps to identify the capital maintenance backlog, the District must determine, through available funding, the optimum period of time to eliminate the backlog.

Recommendations

- 5. WRO should continue to identify and refine the backlog of capital projects.**

Management Response: For the next fiscal year, the identification and refining efforts will be expanded to validate more projects and obtain detail scopes of work. The list is forecasted to expand as documented in last year's report. Furthermore, the capital asset inventory will also include the current ECP projects, as well as the future CERP projects. WRO is actively looking to comprehensively include all the existing and future assets that are scheduled for maintenance. WRO's approach in implementing the Capital improvement plan for the entire system C&SF, ECP, and CERP is the lifecycle cost.

Responsible Department: WRO

Estimated Completion Date: July 2002

- 6. The District should establish goals for reducing the capital maintenance backlog and provide adequate annual funding to achieve this goal.**

Management Response: WRO's goal is to obtain approval for additional resources and funding to fully implement a successful capital improvement program. The current plan calls for eliminating the capital backlog by FY22. This will require an aggressive investment program with Board approval. Innovative budgeting strategies coupled with state of the art technology and contracting out support to address the right amount of preventive maintenance, will lead to a reliable, functional, and cost efficient system.

Responsible Department: WRO

Estimated Completion Date: FY03